BTeV WBS Dictionary

Subproject WBS Level 2 Element Number

WBS 1.13
Controls/Monitoring & Timing

May 12, 2000

This document provides WBS Dictionary information
for a BTeV WBS Level 2 project and all its subprojects.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13

WBS Element Name:

Controls/Monitoring & Timing System

WBS Element Definition:

A distributed network that allows a host PC to control and monitor all electronic systems in the experiment. Implemented as a tree in which each branch point contains a message processing node. Much of the hardware for this is found as part of other subsystems. The system will have ~8,700 endpoints. Control includes: setting mode bits and analog voltages for simple devices. Loading firmware and software to programmable devices. Sending software messages and requests to processing devices. Monitoring includes: receiving status, errors and analog readout from simple devices. Receiving software messages and statistics from processing devices. Timing includes: Sending precise accelerator bunch crossing clocks to devices that need it.

Ground Rules & Assumptions:

The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Summary element

Basis of Estimate:

Purchase Orders and past experience doing similar work

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.1

WBS Element Name:

Accelerator Timing Generator

WBS Element Definition:

This element consists of a system that provides bunch crossing information and precise accelerator timing.

Ground Rules & Assumptions:

The experiment requires bunch crossing information and precise accelerator timing. The system consists of three individual sections. The first section extracts timing signals from the Tevatron. The second section conditions them and re-synchronizes them to a precise frequency. The third section distributes the signals to the experiment. Research, development and production will take 500 days to complete. The EET group of the Particle Physics Division will design this system.

Estimate Source:

The Historical reference based on existing CDF Clock Distribution System for Run II

Basis of Estimate:

Cost is based on knowledge of similar work done on the existing CDF Clock Distribution System for Run II

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

> 1.13.1.1

WBS Element Name:

> Timing R&D

WBS Element Definition:

> This element consists of research time spent on determining how well a timing system can work. Check issues with phase lock loops such as recovery time and stability under missing pulse operation. Research how well the timing system will work when integrated on a chip with other functions such as the Control and Monitoring system. Research issue of using fiber to distribute timing and compare it with copper links.

Ground Rules & Assumptions:

> Use knowledge gained from design of existing CDF Clock Distribution System for Run II. Timing R&D will take 400 days to complete. The EET group of the Particle Physics Division will design this system.

Estimate Source:

> Historical reference based on existing CDF Clock Distribution System for Run II

Basis of Estimate:

> Cost is based on knowledge of similar work done on the existing CDF Clock Distribution System for Run II

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.1.1.1

WBS Element Name:

Phase Locked Loop

WBS Element Definition:

This element consists of R&D time spent on phase lock loops such as recovery time and stability under missing pulse operation.

Ground Rules & Assumptions:

R&D on phase locked loop will take 160 days to complete. The EET group of the Particle Physics Division will design this system.

Estimate Source:

Historical reference based on existing CDF Clock Distribution System for Run II

Basis of Estimate:

Cost is based on knowledge of similar work done on the existing CDF Clock Distribution System for Run II

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

> 1.13.1.1.2

WBS Element Name:

> Fiber Optic Link Accuracy & Jitter

WBS Element Definition:

> This elements consists of R&D on the issue of using optical links to distribute timing and compare it with copper links.

Ground Rules & Assumptions:

> R&D on fiber optic link accuracy, resolution, and jitter will take 120 days to complete. The EET group of the Particle Physics Division will design this system.

Estimate Source:

> Historical reference based on existing CDF Clock Distribution System for Run II

Basis of Estimate:

> Cost is based on knowledge of similar work done on the existing CDF Clock Distribution System for Run II

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.1.1.3

WBS Element Name:

Copper Link Accuracy & Jitter

WBS Element Definition:

This elements consists of R&D on the issue of using copper links to distribute timing and compare it with fiber optic links.

Ground Rules & Assumptions:

R&D on copper link accuracy, resolution and jitter will take 120 days to complete. The EET group of the Particle Physics Division will design this system.

Estimate Source:

Historical reference based on existing CDF Clock Distribution System for Run II

Basis of Estimate:

Cost is based on knowledge of similar work done on the existing CDF Clock Distribution System for Run II

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

> 1.13.1.2

WBS Element Name:

> Accelerator Timing System Interface

WBS Element Definition:

> This element defines the Timing Systems' interface to Tevatron.

Ground Rules & Assumptions:

> The current interface to the Tevatron is a system consisting of standard off the shelf NIM modules in a single subrack. The interface to the Tevatron will take 60 days to complete. The EET group of the Particle Physics Division will design this system.

Estimate Source:

> Historical reference based on existing CDF Clock Distribution System for Run II

Basis of Estimate:

> Cost is based on knowledge of similar work done on the existing CDF Clock Distribution System for Run II

WBS Element Number:

1.13.1.2.1

WBS Element Name:

Cables From/To Accelerator Timing Signals

WBS Element Definition:

This element consists of the Tevatron signals, beam pickup signals and the link to the signal conditioning logic located in the NIM subrack.

Ground Rules & Assumptions:

The current system uses copper cable links. The link to the interface will take 60 days to complete. The EET group of the Particle Physics Division will design this system.

Estimate Source:

Historical reference based on existing CDF Clock Distribution System for Run II

Basis of Estimate:

Cost is based on knowledge of similar work done on the existing CDF Clock Distribution System for Run II

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

> 1.13.1.2.2

WBS Element Name:

> Circuit Boards

WBS Element Definition:

> This element describes the Accelerator Synchronization Module, the Phase Coherent Clock Module, and the Sequencer Module in the clock distribution system.

Ground Rules & Assumptions:

> R&D for the Accelerator Synchronization Module, the Phase Coherent Clock Module, and the Sequencer Module will take 360 days to complete. The EET group of the Particle Physics Division will design this system.

Estimate Source:

> Historical reference based on existing CDF Clock Distribution System for Run II

Basis of Estimate:

> Cost is based on knowledge of similar work done on the existing CDF Clock Distribution System for Run II

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.1.2.2.1

WBS Element Name:

Development & Prototypes

WBS Element Definition:

This element describes the development and prototypes of the Accelerator Synchronization Module, the Phase Coherent Clock Module, the Selector Fanout Module and the Sequencer Module in the clock distribution system.

Ground Rules & Assumptions:

R&D on system accuracy, resolution, jitter, and drift for the Accelerator Synchronization Module, the Phase Coherent Clock Module, and the Sequencer Module will take 360 days to complete. There will be 2 prototypes of each module required for the first iteration. The EET group of the Particle Physics Division will design this system.

Estimate Source:

Historical reference based on existing CDF Clock Distribution System for Run II

Basis of Estimate:

Cost is based on knowledge of similar work done on the existing CDF Clock Distribution System for Run II

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

> 1.13.1.2.2.2

WBS Element Name:

> Production

WBS Element Definition:

> This element describes the production of the Accelerator Synchronization Module, the Phase Coherent Clock Module, the Sequencer Module, and the Selector Fanout Module in the clock distribution system.

Ground Rules & Assumptions:

> The production quantities will be 3 of each module. Production deliveries for the Accelerator Synchronization Module, the Phase Coherent Clock Module, and the Sequencer Module will take 120 days to complete. The EET group of the Particle Physics Division will design this system.

Estimate Source:

> Historical reference based on existing CDF Clock Distribution System for Run II

Basis of Estimate:

> Cost is based on knowledge of similar work done on the existing CDF Clock Distribution System for Run II

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.2

WBS Element Name:

Control/Monitor Host & Timing Interface

WBS Element Definition:

Host computer with interface to the Accelerator Timing Generator (1.13.1) and the control and monitoring network. This provides a user interface via a keyboard as well as a gateway to the internet.

Ground Rules & Assumptions:

The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Summary element.

Basis of Estimate:

Purchase order for similar equipment and knowledge of other similar purchases.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.2.1

WBS Element Name:

Host computer (Windows PC)

WBS Element Definition:

This WBS element consists of a high powered computer with multiple PCI slots, a big monitor screen, and an internet connection.

Ground Rules & Assumptions:

The type of computer to be used in the system will be evaluated by using it in the test stands for prototype testing. Delivery of the computer will take 30 days. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the requisition of this system.

Estimate Source:

The costs are based on vendor information.

Basis of Estimate:

The cost estimates are from previous purchases.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.2.2

WBS Element Name:

Host Controller Control/Monitoring & Timing Fanout

WBS Element Definition:

This element consists of a PCI card with large buffer memory and 2-channel link controller. There will be 10 of these PCI cards in the host computer. The Timing Fanout section of the PCI card consists of a FPGA, receiver, transmitters and supporting components that receive the clock from the timing generator and retransmits multiple copies out to the Control/Monitoring and Timing Hubs.

Ground Rules & Assumptions:

The system requires a maximum of 10 PCI cards to distribute control and timing signals and receive monitoring information to/from the HUB sections. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for similar modules in applicable quantities.

Basis of Estimate:

Costs are based on vendor information for modules that provide similar functions.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.2.2.1

WBS Element Name:

Development and Prototypes

WBS Element Definition:

This element consists of the time spent developing a PCI card with large buffer memory and 2-channel link controller. Two prototypes will be used in the host computer. The Timing Fanout section of the PCI card consists of a FPGA, receiver, transmitters and supporting components that receive the clock from the timing generator and retransmits multiple copies out to the Control/Monitoring and Timing Hubs.

Ground Rules & Assumptions:

Research and development will take 125 days to complete. There will be 2 prototypes required for the first iteration. There will be 6 pre-production modules required for the development stage. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Development and Prototype costs are from experiences with previous projects.

Basis of Estimate:

Costs are based on past experience doing similar work.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.2.2.1.1

WBS Element Name:

Control/Monitoring Circuitry

WBS Element Definition:

A small embedded processor with RAM, Flash EPROM, FPGA, and Monitor and Control links. It is offered as a module that can be placed in a larger design to provide monitor and control functions.

Ground Rules & Assumptions:

There will be 2 prototypes required for the first iteration. There will be 6 pre-production systems required for the development stage. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.2.2.1.2

WBS Element Name:

Timing Circuitry

WBS Element Definition:

The Timing Circuitry consists of a FPGA, receiver, transmitters and supporting components that receive the clock from the timing generator and then fans it out to the Control/Monitoring and Timing Hubs.

Ground Rules & Assumptions:

There will be 2 prototypes required for the first iteration. There will be 6 pre-production systems required for the development stage. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.2.2.1.3

WBS Element Name:

Interface to Fermilab's Fire Alarm System

WBS Element Definition:

An integrated temperature monitor, FPGA and supporting components that monitor the sensitive components at the printed circuit board level and will send a signal to the Fire Alarm System during critical conditions.

Ground Rules & Assumptions:

There will be 2 prototypes required for the first iteration. There will be 6 pre-production modules required for the development stage The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.2.2.1.4

WBS Element Name:

Link Interfaces

WBS Element Definition:

This element consists of a small FPGA and a transmitter that drives 2 Control & Timing links and a receiver that receives monitoring information.

Ground Rules & Assumptions:

There will be 2 prototypes required for the first iteration. There will be 6 pre-production modules required for the development stage. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.2.2.2

WBS Element Name:

Production

WBS Element Definition:

This element consists of the production quantities for the Host Controller modules in the system.

Ground Rules & Assumptions:

There will be 10 Host Controller modules in the full system. Delivery of production quantities will take 60 days to complete. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on vendor information for modules that provide similar functions.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

> 1.13.3

WBS Element Name:

> Control/Monitoring & Timing Hub

WBS Element Definition:

> This element consists of a Hub that receives a Monitor/Control & Timing link and fans it out to 24 Monitor/Control & Timing links. It contains a control processor with buffer memory and large non-volatile storage.

Ground Rules & Assumptions:

> The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

> Summary element

Basis of Estimate:

> Costs are based on vendor information for modules that provide similar functions and past experience doing similar work.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.3.1

WBS Element Name:

Development & Prototypes

WBS Element Definition:

A small embedded microprocessor with RAM, Flash EPROM, FPGA, and Monitor and Control links. It is offered as a module that can be placed in a larger design to provide monitor and control functions.

Ground Rules & Assumptions:

Research and development will take 250 days to complete. There will be 2 prototypes required for the first iteration. There will be 10 pre-production systems required for the development stage. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.3.1.1

WBS Element Name:

Control/Monitoring Circuitry

WBS Element Definition:

A low-cost microprocessor with significant amount of on-chip RAM or Flash ROM and a Large (1-2 Mbit) Flash EPROM for storing firmware and software. A FPGA that receives a single M.A.C. link and drives as many as 24 M.A.C. links. Consists mostly of DMA controllers. RAM chip for message buffering (128K x 16)

Ground Rules & Assumptions:

There will be 2 prototypes required for the first iteration. There will be 10 pre-production systems required for the development stage. T he Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.3.1.2

WBS Element Name:

Timing Circuitry

WBS Element Definition:

The Timing Circuitry consists of a FPGA, receiver, transmitters and supporting components that receive the clock from the timing generator and transmits multiple copies out to the Control/Monitoring and Timing ICs.

Ground Rules & Assumptions:

There will be 2 prototypes required for the first iteration. There will be 10 pre-production systems required for the development stage. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.3.1.3

WBS Element Name:

Alarms & Limits Circuitry & Cabling

WBS Element Definition:

This element consists of an integrated temperature monitor, FPGA and supporting components that monitor the sensitive components at the printed circuit board level and sends signals to the Fire Alarm System during critical conditions.

Ground Rules & Assumptions:

There will be 2 prototypes required for the first iteration. There will be 10 pre-production systems required for the development stage. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.3.1.4

WBS Element Name:

Alarms & Limits Interface to Fermilab's Fire Alarm System

WBS Element Definition:

This element consists of a FPGA, receiver, transmitter and supporting components that receives the from each Alarms & Limits Circuitry and transmits the signal to the Fermilab Fire Alarm System.

Ground Rules & Assumptions:

Research and development will take 30 days to complete. There will be 2 prototype required for the first iteration. There will be 10 Pre-production modules in the system. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.3.1.5

WBS Element Name:

Link Interfaces

WBS Element Definition:

A small FPGA that receives a single M.A.C. link and drives as many as 24 M.A.C. links. Consists mostly of DMA controllers.

Ground Rules & Assumptions:

There will be 2 prototypes required for the first iteration. There will be 10 pre-production systems required for the development stage. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.3.2

WBS Element Name:

Production

WBS Element Definition:

This element consists of the production quantities for the Hubs in the system.

Ground Rules & Assumptions:

There will be ~380 hubs in the full system. Delivery of production quantities will take 120 days to complete. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on vendor information for modules that provide similar functions and past experience doing similar work.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.4

WBS Element Name:

Control/Monitoring & Timing

WBS Element Definition:

This element consists of copper or optical cable that connects Control/Timing & Monitoring nodes between boxes.

Ground Rules & Assumptions:

The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.4.1

WBS Element Name:

Control/Timing & Monitoring Links

WBS Element Definition:

This element consists of copper or optical cable that connects Control/Timing & Monitoring nodes between boxes.

Ground Rules & Assumptions:

Prototyping will require ~5 samples. There will be 15 links required for the development stage. Research and development will take 150 days to complete. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.4.1.1

WBS Element Name:

Development & Prototypes

WBS Element Definition:

This element consists of the research required to compare copper links to optical links between the Hub and front end electronics.

Ground Rules & Assumptions:

Prototyping will require ~5 samples. There will be 15 links required for the development stage. Research and development will take 150 days to complete. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on past experience doing similar work.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.4.1.2

WBS Element Name:

Production

WBS Element Definition:

This element consists of production quantities of copper or optical cable.

Ground Rules & Assumptions:

There will be ~8700 links required for the full system. Delivery of production quantities will take 80 days to complete. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on vendor information.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.4.2

WBS Element Name:

Monitoring Interface From Data Acquisition System Flow Controller

WBS Element Definition:

This element consists of the monitoring interface from the data acquisition system flow controller to the Control/Monitoring & Timing System.

Ground Rules & Assumptions:

The circuitry consists of a FPGA, fiber optic receiver and supporting components on the printed circuit board that indicates an error condition has been received from the Data Acquisition System Flow Controller. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on past experience doing similar work.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.4.2.1

WBS Element Name:

Development & Prototypes

WBS Element Definition:

This element consists of the monitoring interface from the data acquisition system flow controller to the Control/Monitoring & Timing System.

Ground Rules & Assumptions:

Research and development will take 60 days to complete. There will be one prototype required for the first iteration. There will be 1 sub-system required for the development stage. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on past experience doing similar work.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.4.2.2

WBS Element Name:

Production

WBS Element Definition:

This element consists of the monitoring interface from the data acquisition system flow controller to the Control/Monitoring & Timing System.

Ground Rules & Assumptions:

There will be one of this subsystem in the full system. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on past experience doing similar work.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.5

WBS Element Name:

Packaging, Power, Cooling & Protection

WBS Element Definition:

This element defines the system packaging, power, cooling and protection.

Ground Rules & Assumptions:

The routing hub needs a small case and power supply with minimal cooling. It can probably use the same type of rack-mount boxes used by commercial Ethernet routers. There will be ~380 hubs in the system. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on past experience doing similar work.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.5.1

WBS Element Name:

Development & Prototypes

WBS Element Definition:

Two prototype hubs are needed for system development. The routing hub needs a small case and power supply with minimal cooling. It can probably use the same type of rack-mount boxes used by commercial Ethernet routers.

Ground Rules & Assumptions:

Research and development will take 30 days to complete. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on past experience doing similar work.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.5.2

WBS Element Name:

Production

WBS Element Definition:

This element consists of the ~380 hubs needed for final system. The routing hub needs a small case and power supply with minimal cooling. It can probably use the same type of rack-mount boxes used by commercial Ethernet routers.

Ground Rules & Assumptions:

There will be ~380 hubs in the system. To fill Production quantities will take 40 days. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the design of this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on past experience doing similar work.

BTeV WBS Dictionary

Basis of Cost Estimate

WBS Element Number:

1.13.6

WBS Element Name:

Rad-Hard C/M&T ICs for Pixel and Microstrip Systems

WBS Element Definition:

This element describes the rad-hard control/monitoring and timing ICs that will be implemented on the BTeV Pixel and Microstrip systems. This covers prototyping costs and any production associated costs, but not the production component costs. The C/M&T ICs receives serial control commands with the embedded 53Mhz system clock, recovers the 53Mhz system clock, and decodes the control commands. The C/M&T IC also generates any necessary monitoring data.

Ground Rules & Assumptions:

The C/M&T link will be rad-hard and 106Mbps. Assume 3 prototype runs are required.

Estimate Source:

Fermilab, ASIC group. Fermilab, Electronic Systems Engineering Department personnel.

Basis of Estimate:

Time estimates are based on historical experiences with projects of similar complexity. Component costs are based on prototype quantities.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.6.1

WBS Element Name:

Development and Prototypes

WBS Element Definition:

This element describes the rad-hard control/monitoring and timing ICs that will be implemented on the BTeV Pixel and Microstrip systems. This covers prototyping components and test fixuring costs. The C/M&T ICs receives serial control commands with the embedded 53Mhz system clock, recovers the 53Mhz system clock, and decodes the control commands. The C/M&T IC also generates any necessary monitoring data.

Ground Rules & Assumptions:

The C/M&T link will be rad-hard and 106Mbps. Assume 3 prototype runs are required.

Estimate Source:

Fermilab, ASIC group. Fermilab, Electronic Systems Engineering Department personnel.

Basis of Estimate:

Time estimates are based on historical experiences with projects of similar complexity. Component costs are based on prototype quantities.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.6.1.1

WBS Element Name:

Prototype Run 1

WBS Element Definition:

This element describes the 1st prototype rad-hard control/monitoring and timing ICs that will be implemented on the BTeV Pixel and Microstrip systems. This covers prototyping components. The C/M&T ICs receives serial control commands with the embedded 53Mhz system clock, recovers the 53Mhz system clock, and decodes the control commands. The C/M&T IC also generates any necessary monitoring data.

Ground Rules & Assumptions:

The C/M&T link will be rad-hard and 106Mbps.

Estimate Source:

Fermilab, ASIC group.
Fermilab, Electronic Systems Engineering Department personnel.

Basis of Estimate:

Time estimates are based on historical experiences with projects of similar complexity.
Component costs are based on prototype quantities.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.6.1.2

WBS Element Name:

Prototype Run 2

WBS Element Definition:

This element describes the 2nd prototype rad-hard control/monitoring and timing ICs that will be implemented on the BTeV Pixel and Microstrip systems. This covers prototyping components. The C/M&T ICs receives serial control commands with the embedded 53Mhz system clock, recovers the 53Mhz system clock, and decodes the control commands. The C/M&T IC also generates any necessary monitoring data.

Ground Rules & Assumptions:

The C/M&T link will be rad-hard and 106Mbps.

Estimate Source:

Fermilab, ASIC group.
Fermilab, Electronic Systems Engineering Department personnel.

Basis of Estimate:

Time estimates are based on historical experiences with projects of similar complexity.
Component costs are based on prototype quantities.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.6.1.3

WBS Element Name:

Prototype Run 3

WBS Element Definition:

This element describes the 3rd prototype rad-hard control/monitoring and timing ICs that will be implemented on the BTeV Pixel and Microstrip systems. This covers prototyping components. The C/M&T ICs receives serial control commands with the embedded 53Mhz system clock, recovers the 53Mhz system clock, and decodes the control commands. The C/M&T IC also generates any necessary monitoring data.

Ground Rules & Assumptions:

The C/M&T link will be rad-hard and 106Mbps.

Estimate Source:

Fermilab, ASIC group. Fermilab, Electronic Systems Engineering Department personnel.

Basis of Estimate:

Time estimates are based on historical experiences with projects of similar complexity. Component costs are based on prototype quantities.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.6.1.4

WBS Element Name:

Test Fixtures

WBS Element Definition:

This element describes the test fixturing costs for rad-hard control/monitoring and timing ICs that will be implemented on the BTeV Pixel and Microstrip systems. This covers prototyping components. The C/M&T ICs receives serial control commands with the embedded 53Mhz system clock, recovers the 53Mhz system clock, and decodes the control commands. The C/M&T IC also generates any necessary monitoring data. Test fixuring will be used to wafer probe the ICs prior to board installation.

Ground Rules & Assumptions:

The C/M&T link will be rad-hard and 106Mbps.

Estimate Source:

Fermilab, ASIC group.
Fermilab, Electronic Systems Engineering Department personnel.

Basis of Estimate:

Time estimates are based on historical experiences with projects of similar complexity.
Costs estimates based on previous fixturing costs for components of similar complexity.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.6.2

WBS Element Name:

Production Ordering and Testing

WBS Element Definition:

This element describes the production ordering and testing costs for rad-hard control/monitoring and timing ICs that will be implemented on the BTeV Pixel and Microstrip systems. The C/M&T ICs receives serial control commands with the embedded 53Mhz system clock, recovers the 53Mhz system clock, and decodes the control commands. The C/M&T IC also generates any necessary monitoring data. Test fixuring will be used to wafer probe the ICs prior to board installation.

Ground Rules & Assumptions:

The C/M&T link will be rad-hard and 106Mbps.

Estimate Source:

Fermilab, ASIC group. Fermilab, Electronic Systems Engineering Department personnel.

Basis of Estimate:

Time estimates are based on historical experiences with projects of similar complexity.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.7

WBS Element Name:

Hardware & Software Specific to the Development & Testing of the IC

WBS Element Definition:

This element consists of the development and testing using a PCI interface card in a PC with NT operating system and a software package that allows designers to develop test routines.

Ground Rules & Assumptions:

Six PC's with NT operating system and extra PCI slots will be needed for testing. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for acquiring this system.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on a P.O. to purchase similar equipment.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.7.1

WBS Element Name:

Development and Test Hardware

WBS Element Definition:

Development and testing will be done using PCI interface cards in a PC with NT operating system.

Ground Rules & Assumptions:

Six PC's with NT operating system and extra PCI slots will be needed for testing. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for acquiring these systems.

Estimate Source:

Costs are based on vendor information for applicable quantities.

Basis of Estimate:

Costs are based on previous in-house designs.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.7.1.1

WBS Element Name:

Control/Monitoring & Timing IC Probe Station Adapter

WBS Element Definition:

This element is a Control/Monitoring & Timing IC Probe Station Adapter.

Ground Rules & Assumptions:

One adapter is required for testing ICs. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for acquiring this adapter.

Estimate Source:

Costs are based on vendor information.

Basis of Estimate:

Costs are based on past experience doing similar work.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.7.1.2

WBS Element Name:

Adapters to BTeV-Standard Test Stands

WBS Element Definition:

This element is a PCI based Adapter to BTeV-Standard Test Stands.

Ground Rules & Assumptions:

Six adapters are required so that each individual user can perform testing under there own conditions. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for acquiring these adapters.

Estimate Source:

Vendor supplied information.

Basis of Estimate:

Cost is based on vendor supplied information for similar equipment.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.7.2

WBS Element Name:

Development & Test Software

WBS Element Definition:

This element is the software package, such as Labview, that will enable designers to develop test programs to test prototype hardware of the Control/Monitoring & Timing System.

Ground Rules & Assumptions:

Three software packages are needed for development. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for acquiring this software.

Estimate Source:

The source is vendor supplied information.

Basis of Estimate:

Cost is based on vendor supplied information.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

> 1.13.7.2.1

WBS Element Name:

> Control/Monitoring Software

WBS Element Definition:

> This element is the software package, such as Labview, that will enable designers to develop programs for prototype testing.

Ground Rules & Assumptions:

> Three software packages are needed for development. The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for acquiring this software.

Estimate Source:

> The source is vendor supplied information.

Basis of Estimate:

> Cost is based on vendor supplied information.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

> 1.13.8

WBS Element Name:

> ES&H

WBS Element Definition:

> This element covers the costs of ES&H issues of all components associated with the Controls/Monitoring & Timing project, complying with the Fermilab ES&H policies and implementations. Safety reviews and training are included, as well as overall safety issues such as gas systems, power supplies and cabling, front end electronics, environment and radiation safety.

Ground Rules & Assumptions:

> Follow guidelines provided in the Fermilab ES&H Manual (FESHM). Provide training in ES&H and maintain ES&H programs for appropriate aspects of environmental protection, industrial safety, electrical safety, radiation safety, emergency preparedness, fire protection, waste management and transportation of hazardous materials.
> All applicable BTeV Standards and Methodology guidance apply.
> All applicable ES&H guidance applies, which includes Fermilab mandatory periodic safety training on Radiation, Hazardous Materials, Gas systems, High Voltage, Low Voltage, Machine Shop safety, etc. as applicable.

Estimate Source:

> Cost is time spent reviewing FESHM documents to check for compliance.
> Cost is time spent away from performing normal tasks to attend training classes.

Basis of Estimate:

> Previous experience with experiments of similar complexity.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.8.1

WBS Element Name:

Electrical & Electronics

WBS Element Definition:

This element defines the Fermilab Electrical Safety Program.

Ground Rules & Assumptions:

Electronic and electrical equipment should be designed in regard to Fermilab ES&H policies as outlined in FESHM Chapter 5040. Commercial products used in the systems' design must conform to the proper electrical codes.

Estimate Source:

Cost is time spent reviewing FESHM documents to check for compliance

Basis of Estimate:

Knowledge of other similar training.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.8.2

WBS Element Name:

Environmental

WBS Element Definition:

This element describes the Fermilab Environmental Protection Program.

Ground Rules & Assumptions:

Follow the Fermilab program for protecting the environment, assuring compliance with applicable environmental standards, and avoiding adverse environmental impact from Laboratory activities. The Controls/Monitoring & Timing System will be designed according to the rules outlined in the Laboratory Environmental Protection Program as per FESHM chapter 8000.

Estimate Source:

Cost is time spent reviewing FESHM documents to check for compliance

Basis of Estimate:

Knowledge of other similar training

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.8.3

WBS Element Name:

Radiation Safety

WBS Element Definition:

This item is the Fermilab Radiological Control Policy.

Ground Rules & Assumptions:

The Controls/Monitoring & Timing System will be designed according to the rules outlined in the Laboratory Radiation Safety Program as per FESHM chapter 10000.

Estimate Source:

Cost is time spent reviewing FESHM documents to check for compliance

Basis of Estimate:

Knowledge of other similar training

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.8.4

WBS Element Name:

Training

WBS Element Definition:

This element consists of ES&H training for all individuals.

Ground Rules & Assumptions:

Fermilab requires training for protecting the environment, assuring compliance with applicable environmental standards, and avoiding adverse environmental impact from Laboratory activities. Fermilab requires radiological safety training for those individuals at the laboratory who work in areas controlled for radiological purposes and with radioactive materials.

Estimate Source:

Cost is time spent to attend training classes.

Basis of Estimate:

Knowledge of other similar training.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.9

WBS Element Name:

Installation & Testing at C0

WBS Element Definition:

This element defines the integration and testing of the final system at C0.

Ground Rules & Assumptions:

The Fermilab Computing Division Electronic Systems Engineering Department will be responsible for the installation of this system. Individuals will be needed to move equipment to the experiment. Engineers and technicians will be needed to install system components at the experiment. Engineers and technicians will be needed to test system components at the experiment. Installation will take 120 days to complete.

Estimate Source:

Time estimates are based on historical experiences with projects of similar complexity.

Basis of Estimate:

Time estimates are based on historical experiences with projects of similar complexity.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

> 1.13.10

WBS Element Name:

> Controls/Monitoring and Timing Project Management

WBS Element Definition:

> This element consists of the costs associated with all management activities related to the controls/monitoring and timing system.

Ground Rules & Assumptions:

> This element includes coordination of the work carried out at various institutes, site-visit, vendor visit, book-keeping, accounting, and reporting to internal and external reviews of the project. Review at regular intervals is necessary to keep track of the progress of the project. Travel to various sites are needed to coordinate the smooth running of the project and the timely delivery of components needed from the vendors.

Cost Estimate Source:

> The cost is basically an estimate of the number of travels that is deemed to be necessary. It also includes the time that it will take the engineers and technicians to prepare and attend the reviews. Labor is costed at Fermilab rates. All trips are based on experience and costed based on place and length of travel.

Basis of Cost Estimate:

> Estimate is based on experiences with projects of similar complexity.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.10.1

WBS Element Name:

Project Coordination

WBS Element Definition:

This element consists of the effort required to coordinate the design of the Controls/Monitoring & Timing System.

Ground Rules & Assumptions:

A senior engineer from the Fermilab Computing Division Electronic Systems Engineering Department will be responsible for supervising the design of this system.

Estimate Source:

Engineering judgement

Basis of Estimate:

Knowledge of other similar work

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.10.2

WBS Element Name:

Project Reviews

WBS Element Definition:

This element consists of the effort required to coordinate the overall system design reviews, the sub-system component reviews and individual module reviews of the Controls/Monitoring & Timing System.

Ground Rules & Assumptions:

A senior engineer from the Fermilab Computing Division Electronic Systems Engineering Department will be responsible for supervising the design of this system.

Estimate Source:

Engineering judgement

Basis of Estimate:

Knowledge of other similar work

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

> 1.13.10.3

WBS Element Name:

> ES&H Reviews

WBS Element Definition:

> This element consists of the effort required to coordinate the ES&H reviews for the overall system, the sub-system components, and individual modules of the Controls/Monitoring & Timing System. This element defines the Fermilab Environment, Safety and Health Policy and its implementation.

Ground Rules & Assumptions:

> The design of the Controls/Monitoring & Timing System must follow guidelines provided in the Fermilab ES&H Manual (FESHM). The system must conform to ES&H policies for appropriate aspects of environmental protection, industrial safety, electrical safety, radiation safety, emergency preparedness, fire protection, waste management and transportation of hazardous materials. A senior engineer from the Fermilab Computing Division Electronic Systems Engineering Department will be responsible for coordinating ES&H reviews for the design of this system.

Estimate Source:

> Engineering judgement

Basis of Estimate:

> Knowledge of other similar work

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.13.10.4

WBS Element Name:

Travel

WBS Element Definition:

This element consists of information gathering trips to contract manufacturing vendor's sites.

Ground Rules & Assumptions:

There is a need to evaluate the contract manufacturers capabilities before they are added to the list of vendors qualified to bid on jobs such as ASIC manufacturing, printed circuit board fabrication and SMT assembly. Members of the design team from the Fermilab Computing Division Electronic Systems Engineering Department will be responsible for evaluating potential candidates and adding them to a list of qualified contract manufacturers.

Estimate Source:

Engineering judgement

Basis of Estimate:

Knowledge of other similar work